FIREARM ASSEMBLY

FIELD OF THE INVENTION

The present invention relates to firearms, and more specifically to a receiver and safety mechanism for bolt-action firearms.

BACKGROUND OF THE INVENTION

Various methods and configurations for safe and reliable firearms have been developed in the storied history of small arms development. With the advent of smokeless powder in the late 19th century, and the subsequent development of more powerful chamberings in the early 20th century, bolt-action firearms were developed as a way to handle the increased pressures of firing these larger, more powerful rounds. These improvements have continued to develop and advance ballistic performance and have resulted in some very large cartridges, including the .50 BMG.

Generally, a bolt-action firearm comprises a bolt which houses a firing pin. The bolt slides within the firearm receiver between a rearward position which allows loading and unloading of a cartridge, and a forward position. As the bolt slides forward, the cartridge is pushed forward into a firing chamber. The bolt is then typically closed by rotating it into a battery position, thus locking the bolt behind the cartridge. The firing pin is then activated by pulling the trigger which causes the firearm to discharge. To expel the empty casing, the bolt is rotated out of its locked position and slid rearward to extract the empty casing.

As a part of the empty casing extraction, different extractors have been developed. Most throw the casing outward and away from the firearm in either an upward or sidewise direction. This can cause a variety of problems, including striking the user or a bystander, and losing the empty casing which the user often may wish to retain. It is also a problem in military or law enforcement situations when such movement of the flying casing could reveal the location of the shooter. This is especially undesirable in sniping situations.

Another problem which is often sought to be resolved in a variety of ways includes the prevention of accidental or unintended discharge. Because the firing pin is

typically disposed within the bolt, and the bolt (as described above) is typically pushed forward against the rear of the cartridge as the cartridge is advanced into the firing chamber, the potential for unintended discharge of the weapon is present, particularly as the bolt is thrown forward to chamber a round. A variety of solutions have been developed, with varying degrees of success.

Still another problem encountered with the development of higher chamber pressures is seen in the materials used to build these firearms. With the larger pressures generated by the development of larger and more powerful magnum loads and larger cases, more and more material was needed in order to obtain adequate strength. Competing with these increased material dimensions, however, is a desire for lighter-weight (and/or less costly) firearms. One way to remedy the weight problem is to use lighter weight materials (*e.g.,* aluminum instead of steel), but strength problems can result. Thus, some prior art attempts at building adequately strong, yet light weight receivers, have included using aluminum and other light weight materials or alloys where possible in the firearm. This introduced manufacturing challenges, however, because heat treatments and other manufacturing requirements treated the different materials differently.

SUMMARY OF THE INVENTION

The present invention provides a receiver for a firearm comprising a front, at least two sides, and a bottom. The receiver has a front recess to receive a barrel or barrel extension, and is defined by a channel in the receiver which is open longitudinally along a longitudinal slit in the receiver. The receiver also has a load/eject recess open to the front recess and to either a side or bottom of the receiver. The load/eject recess is sized to allow the insertion and removal of a cartridge from the receiver. The slit and the load/eject recess together form a single opening to the receiver whereby the receiver can expand to allow the insertion of a barrel or barrel extension into the front recess. In a

preferred embodiment, the slit and load/eject recess are open to the bottom of the receiver. The receiver is either biased against the insertion of a barrel or barrel extension, such that it must be pried open to allow insertion and its own at rest position (inward bias) provides a compressive force to hold the barrel in place, or, alternatively, it is biased open and a compressive force, such as a bolt, closes the receiver against the barrel or barrel extension.

In a preferred embodiment, the receiver has a front recess to receive a barrel extension, the front recess defined by a channel open longitudinally at its bottom along a longitudinal slit. Included in this preferred embodiment is a load/eject recess open to the front recess and to the bottom of the receiver to allow the insertion and removal of a cartridge from the bottom of the receiver. Also included in this preferred embodiment is at least one clamping hole in the receiver disposed through the longitudinal slit and sized to receive clamping means, such as a bolt. The slit and the load/eject recess together form a single opening along the bottom of the receiver. The front recess is expandable and contractible along the slit whereby the slit is compressible by the clamping means to apply a compressive force on a barrel extension inserted into the front recess.

Also included as a part of the invention is a barrel extension for a firearm barrel. The barrel extension is suited for insertion into the receiver of the present invention. In a preferred embodiment, the barrel extension comprises a metallic tube having an outer surface, and a protrusion extending radially outward from the outer surface of the metallic tube. In a preferred embodiment, the protrusion is a pin.

Still also included in the present invention is a safety mechanism for a firearm to prevent unintentional firing of the firearm. The safety mechanism comprises a bolt having a bolt head disposed at a distal end, a proximal end, and a longitudinal channel disposed in the bolt to house a firing pin. A firing pin is disposed in the longitudinal channel of the bolt, and has a distal end at the bolt head and a proximal end

extending out of the longitudinal channel to allow activation of the firing pin by a hammer. A safety bar is disposed at the proximal end of the firing pin wherein rotation of the bolt into a firing position rotates the safety bar into an activation position whereby the firing pin can be activated by a hammer striking the safety bar, and rotation of the bolt into a non-firing position rotates the safety bar out of the activation position whereby a falling hammer cannot strike the safety bar or firing pin.

Included also is firearm comprising a barrel, a barrel extension attached to the barrel, the barrel extension having a protrusion extending radially therefrom, and a receiver. The receiver comprises a front, at least two sides, and a bottom, a front recess to receive a barrel or barrel extension, the front recess defined by a channel in the receiver which is open longitudinally along a longitudinal slit in the receiver, and a load/eject recess open to the front recess and to at least one side or bottom of the receiver. The load/eject recess is sized to allow the insertion and removal of a cartridge from the receiver. The slit and load/eject recess together form a single opening to the receiver whereby the receiver can expand to allow the insertion of a barrel or barrel extension into the front recess. The slit accepts the protrusion to guide the barrel extension into the receiver. A preferred embodiment of the firearm includes the safety mechanism described above.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a view of a partial firearm in accordance with the present invention with the barrel removed from the receiver;

Fig. 2 is a view of a partial firearm in accordance with the present invention as shown in Fig. 1 but with the barrel inserted into the receiver;

Fig. 3 is a view of a receiver in accordance with the present invention;

Fig. 4 is a view of the underside of the receiver shown in Fig. 3;

Fig. 5 is a view of the front end of the receiver shown in Fig. 3;

Fig. 6 is a view of the receiver of Fig. 3 but with clamping means shown;

Fig. 7 is a view of a barrel, barrel extension, and bolt in accordance with the present invention;

Fig. 8 is a view of a bolt incorporating the safety mechanism of the present invention where the bolt is in an open position;

Fig. 9 is a view of a bolt incorporating the safety mechanism of the present invention where the bolt is in its closed position; and

Fig. 10 is a view of a safety bar in accordance with one embodiment of the safety feature of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides several advantages over known firearm configurations. These advantages are seen with respect to both safety and ease of manufacture. One aspect of the present invention is the receiver. A second aspect relates to a safety mechanism in a novel bolt/firing pin configuration.

Fig. 1 shows a firearm utilizing the receiver aspect of the present invention, with the barrel separated from the receiver for illustration purposes. Specifically, Fig. 1 shows a firearm 100 having barrel 110, receiver 120, and stock 130. Not shown is the trigger assembly, which is not necessary to an understanding of the present invention. Muzzle brake 140 and utility rail 150 (such as a picatinny rail) for a scope or carry handle, are also shown. As can be seen in Fig. 1, barrel 110 is integrally attached to barrel extension 115 in this embodiment. Typically this connection would be a threaded connection, but it could also take the form of other connections including welding or adhesives, among others. Barrel extension 115 in turn extends into receiver

120 and is connected to receiver 120 in accordance with the present invention, as shown in Fig. 2. Fig. 2 is the firearm shown in Fig. 1 but with barrel 110 (along with barrel extension 115) inserted into receiver 120.

Fig. 3 shows receiver 120 in more detail. Fig. 3 shows receiver 120 without utility rail 150 attached thereto, without barrel extension 120 inserted therein, and without stock 130 attached. As can be seen, receiver 120 has front recess 122 formed therein with slit 125 formed along the bottom of the front recess. Front recess 122 is configured to receive either a barrel or a barrel extension. Front recess 122 is defined by a channel open longitudinally at slit 125. Slit 125 is preferably disposed along the bottom of receiver 120 as shown in Fig. 3, but could be located on either side of the receiver (not shown) or top side (not shown) so long as it connects to a load/eject port as described more fully below. Fig. 3 also shows utility rail mounting holes 200 and utility holes 210 such as may be used for mounting a bipod.

Included as a part of receiver 120 is load/eject recess 160, which can be better seen in Fig. 4 which is a bottom-angled view of receiver 120. In this preferred embodiment, the slit and load/eject recess are open to the bottom of the receiver. More specifically, load/eject recess 160 is open to front recess 122 and to the bottom of receiver 120 to allow the insertion and removal of a cartridge (or cartridge casing) from the bottom of receiver 120.

Fig. 5 shows an angled front view of receiver 120 and illustrates the communication between front recess 122 and load/eject recess 160. Load/eject recess 160 allows direct access to the firing chamber when the bolt (shown and discussed below) is open to allow access, through load/eject recess 160, to the firing chamber at the proximal end of the barrel or barrel extension. As can be seen in Figs. 4 and 5, slit 125 and load/eject recess 160 together form a single opening along the bottom of receiver 120. In alternative embodiments, the slit and port may together be positioned on any side of the receiver, including the top side.

The relationship between the receiver's front recess and the barrel or barrel extension (the later of which is shown in Fig. 1), can take a number of forms. The receiver's front recess can: (1) be in a slip-fit relationship with the barrel or barrel extension in which case it can be compressed by means of compression means (discussed in more detail below) after the barrel or barrel extension is inserted; (2) be larger than the outside dimension of the barrel or barrel extension (even more so than the case in (1), above), in which case it is also compressed by means of compression means (discussed in more detail below) after the barrel or barrel extension is inserted; or (3) be smaller than the outer dimension of the barrel or barrel extension, in which case it can be mechanically (or otherwise, such as thermally) expanded to allow the insertion of a barrel or barrel extension into the front recess and allowed to return to its at-rest position and thereby anchor the barrel or barrel extension in place with respect to the receiver.

The combination of slit 125 and load/eject port 160 to form a single opening achieves several advantages. One advantage relates to the connection of the barrel or barrel extension to the receiver. In one embodiment, a mechanical leverage can be applied to the sides of the receiver that are separated by slit 125 and which form front recess 122 so as to pry them apart and allow the insertion of a barrel or barrel extension. When the prying force is removed, the sides can return and clamp the barrel or barrel extension into place.

As in the embodiments shown in Figs. 1-5, there can be clamping holes formed in receiver 120, which are preferably perpendicular to the longitudinal axis of front recess 122 along the length of front recess 122. These clamping holes allow for the insertion of bolts, screws, or other appropriate fasteners through the front portion of receiver 120 to radially compress front recess 122 after a barrel or barrel extension is telescopically positioned within front recess 122. As noted above, although adequate compressive force against the barrel or barrel extension may be achieved by manufacturing a radially inward bias in the receiver so that the at-rest position of front recess 122 is smaller than the barrel or barrel extension radius, the use of appropriate

fasteners as described above can aide in this compressive and clamping force. Alternatively, the at-rest position of the receiver can be substantially the same as the outer dimension of the barrel or barrel receiver (as in the slip-fit arrangement described above), or greater than the barrel or barrel extension radius. In such cases, the fastening means just described can be the sole source of compressive force. In either of the above three embodiments, however, adequate force is achieved through compression to hold the barrel in place. Because the cartridge to be fired is placed into the barrel or barrel extension, and it is the barrel or barrel extension which contains the explosive pressure of the ignited charge in the casing during firing, the receiver's only job is to hold the barrel (and/or barrel extension) in place with respect to the remaining parts of the rifle. The advantages to this configuration will be discussed in more detail below.

Another advantage to the receiver configuration discussed above relates to both ergonomic and safety advantages, particularly when the rifle is to be used for tactical purposes (although the advantages can be enjoyed for both hunting and target shooting scenarios as well). This aspect concerns the fact that the loading of a cartridge, as well as the unloading of a cartridge casing or an unfired cartridge, is preferably done with minimal movement. The receiver configuration described above allows for minimal cartridge movement with minimal hand movement. Importantly, it allows for the ejection, by hand, of empty casings so that, unlike the case with most prior art ejectors, the casing does not fly away from the weapon and operator, and risk sun glare reflection and the position compromise associated therewith. Moreover, with the design noted above, particularly in the embodiment with the slit and port disposed at the bottom of the receiver, the operator can easily position his hand directly beneath the bottom opening to allow the cartridge or empty casing to drop directly into his hand or a positioned container as the bolt is pulled rearward. Still another advantage is seen when an unfired cartridge is removed. Prior art rifles which forcibly eject live rounds risk unintended ignition of those live rounds when they strike the ground. The present receiver configuration reduces such a risk considerably.

Still another advantage with the slit/open port configuration of the present invention relates to the manufacture and durability of the rifle. The receiver of the present invention is not subject to forces from the operating pressures of cartridge firing (except, of course, for recoil related stresses). Because it is the barrel or barrel extension which contains firing chamber pressures upon cartridge detonation, the receiver component of the rifle according to the present invention provides a rigid housing from an alloy or polymer that is relatively immune to temperature, moisture, and stress failures, despite the low overall ultimate tensile strength of these materials compared to traditional steel. Due to the overall lower requirements for alloy or polymer strength, there is no need to harden and temper the alloy or polymer in order to increase its overall strength. In distinction, of course, is the fact that hardening and tempering is a virtual necessity for traditional steel receivers in order to increase the overall strength of those receivers. Thus, the characteristics of appropriate alloys and polymers benefit overall weight, accuracy, reliability, wear reduction, and ease of manufacture. The light weight alloy or polymer used for the receiver of the present invention will allow for a receiver size which is dimensionally larger than the typical steel receivers and stock combinations but which will maintain a near equivalent weight.

As noted above, and as shown in Fig. 6, bolt 600 is shown removed from bolt clamping hole 610. Other compressive means could be used and can imagined by those skilled in the fastening art. A screw or bolt, with any head configuration, could be used. The number of fastening means and holes is also not critical, although the most preferred number is four. More than one hole is preferred so that should one fastener loosen, at least one other will maintain the compression against the barrel or barrel extension.

In addition to slit 125 allowing the necessary movement of front recess 122 to allow insertion of the barrel or barrel extension, the fact that slit 125 extends to load/eject recess 160 to form a single opening along receiver 120 is important to allow this movement. Because of the openings in receiver 120 as discussed, much more "give"

is provided for along front recess 122 to allow the insertion of a barrel or barrel extension, as compared to the case where a slit would end at the back (or proximal) end of front recess 122. Moreover, the slit and load/eject port combine to allow easier insertion of a barrel or barrel extension by providing more flexibility within the frame of receiver 120 (as compared to a slit alone).

Another benefit to the mechanical advantage gained by the slit/port combination is seen with respect to the alignment of a barrel or barrel extension during insertion. It should be noted here that although the invention concerns the insertion of a barrel or barrel extension, preferably a barrel extension will be what is inserted into receiver 120. This is especially true in the case of larger caliber chamberings, such as the .50 BMG. In such cases, the barrel itself will be connected to a thicker-walled barrel extension which houses the firing chamber. The thicker wall is necessary to withstand the pressures generated during firing of such chamberings. Thus, for purposes of this discussion, the embodiment using a barrel extension (as is shown in Fig. 1) will be addressed. The invention is not necessarily limited, however, to situations where a barrel extension is inserted directly into the receiver of the present invention, but would include those situations where just a barrel is inserted, or where the barrel and barrel extension may be integrally formed to form a single unitary barrel with a flared end.

As shown in Fig. 7, barrel extension 700 is shown disposed opposite bolt 710 which is the position of bolt 710 before bolt 710 is pushed forward and rotated down into its battery position within barrel extension 700. The mating relationship between barrel extension 700 and bolt 710, particularly bolt head 720, is known to those skilled in the art. In this embodiment, barrel extension 700 is a metallic tube to which barrel 730 is fixedly attached. Not shown in Fig. 7 is a cartridge which would be inserted, as bolt 710 closes into battery, within barrel extension 700 and perhaps part of barrel 730. Important in this embodiment is protrusion 750 which is shown extending from the outer surface of barrel extension 700. In a preferred embodiment, protrusion 750 is a pin.

Protrusion 750 slides into and along slit 125 of front recess 122 of receiver 120 as barrel extension 700 is inserted into receiver 120 during assembly/manufacture. This alignment is important because, as noted above (and as shown in Fig. 7), bolt head 720 mates with barrel extension 700 during closing of the action as indicated by the arrow in Fig. 7. Because barrel 730 and barrel extension 700 are round, but the bolt head/barrel extension relationship is not, proper orientation of the barrel and barrel extension is necessary during assembly to achieve proper bolt/barrel extension alignment. This alignment is easily realized through the use of protrusion 750 and its relationship to slit 125 during insertion of barrel extension 700 into receiver front recess 122. Moreover, by providing protrusion 750 extending perpendicularly from a tangent on barrel extension 700 (or directly from barrel 730 in an embodiment where no barrel extension is used), the barrel extension can be easily inserted into the receiver without the need for angular alignment gauges. The bolt head will always enter and exit the extension opening without impacting the opening of the extension during use. Protrusion 750 is preferably a pin, as shown, but could take the form of a rail or any other suitable guide.

Another aspect of the firearm assembly in accordance with the present invention relates further to the bolt itself and its relationship with a hammer. Fig. 8 shows a bolt in accordance with this aspect of the invention. Specifically, Fig. 8 shows bolt 800 with bolt head 820 disposed at its distal end. Also shown is handle 840. Within bolt 800 is a longitudinal channel disposed in the bolt to house a firing pin. The proximal tip of the firing pin extends slightly proximal to the end of the firing pin channel and has a distal end at the bolt head and a proximate end extending out of the longitudinal channel to allow activation of the firing pin by a hammer. In this embodiment, a recess 850 is cut from a section of bolt 800 to allow access by a hammer (not shown) to the proximal end of the firing pin (not shown). In an alternative embodiment, the proximal end of the firing pin could simply extend out the back of bolt 800.

As can be seen in Fig. 8, safety bar 860 is disposed at the proximal end of the firing pin. When bolt 800 is in its open position, such as is shown in Fig. 8, safety bar

860 is rotated such that a hammer strike to the bolt would impact a point indicated by reference numeral 870. In such a case, no movement of the firing pin would result because the hammer would not transfer a force to the proximal end of the firing pin. The hammer, in such case, would strike the bolt face at point 870 but not the firing pin.

Fig. 9 shows the same bolt as that of Fig. 8, but which has been rotated 90° into what would be a fully closed, or battery, position. As can be seen from Fig. 9, rotation of bolt 800 into a firing position rotates safety bar 860 into an activation position whereby the firing pin can be activated by a hammer striking and contacting safety bar 860 at point 870. As noted above, bolt head 820 is also rotated into its battery position. Then, after firing, rotation of bolt 800 via handle 840 into a non-firing position rotates safety bar 860 out of the activation position whereby a falling hammer cannot strike safety bar 860 and cause unintended firing.

The safety mechanism just described can be utilized in a firearm having any degree of bolt rotation between a fully closed position (firing position) and a fully open position. Typically this angle is between 60° and 100°. Preferably, the angle of rotation of the bolt between the fully closed position and fully open position, however, is between 85° and 95°, and most preferably it is 90° . Because of the safety mechanism just described, however, the bolt does not have to rotate to its fully open position for the firearm to be in a non-firing condition. Preferably, the safety bar will move from its activation position (Fig. 9) to a non-firing position by a bolt rotation of between only 20° and 50°, preferably about 30°, from its fully closed position.

Although safety bar 860 is shown in the above embodiment as rectangular, a rounded edge embodiment, such as is shown in Fig. 10, could be used to decrease even further the chance of a hammer striking the firing pin until the bolt is completely (or nearly completely) closed. The use of this embodiment would mean that the safety bar will move from its activation position to a non-firing condition by only a small upward bolt rotation, for example only 10°, from the bolt's fully closed position.

Although the invention is illustrated and described herein with reference to specific embodiments, the invention is not intended to be limited to the details shown. Rather, various modifications may be made in the details within the scope and range of equivalents of the claims and without departing from the invention.